

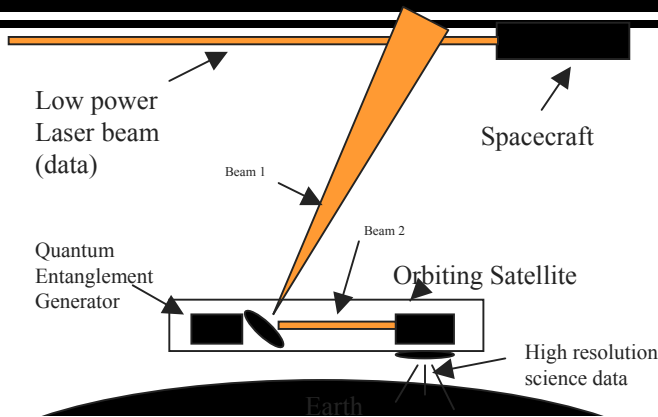


# SSP Science

## Photon Quantum Teleportation



SSP satellite  
could provide  
high data rate,  
instantaneous  
communication



An SSP orbiting satellite generates two entangled beams . One beam (1) interacts with a low-power laser beam containing science data generated by a remote spacecraft. The other beam (2) interacts with a laser beam inside the satellite, creating a duplicate of the beam generated by the spacecraft. The satellite relays the high resolution science data to Earth by conventional means.

### Introduction/Background

- Quantum Teleportation of a laser beam has been demonstrated .
- Information contained in a laser beam is instantly replicated in a separate location when it interacts with an quantum entangled beam of light.

### SSP Quantum Science

- Investigate quantum teleportation scenarios, technical characteristics and assess importance to acquisition of remote data including expected 100% secure encryption and high data rates.
- Develop comparison of SSP -based quantum teleportation communicator to conventional means and access scientific opportunities
- First step will be to evaluate ground-based communications prototype.

### Expected Results

- Potential revolution in long-distance communication.
- Prototype unit will form the basis for NASA/DoD/Intelligence Agencies evaluation for field deployment.

### Why this could be important as part of the SSP program

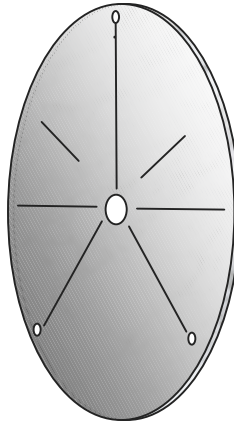
- The ability to teleport information over planetary distances could have profound implications to the quality and type of operations/science data.
- Future human missions will likely require a combination of hands-on and telepresence operations which require secure, high data rate communication.



# SSP Science



## Deployable, Field Programmable Ultralight Sensor



Ultralight carbon-carbon microtruss matrix with embedded advanced field programmable gate array sensors

### Introduction/Background

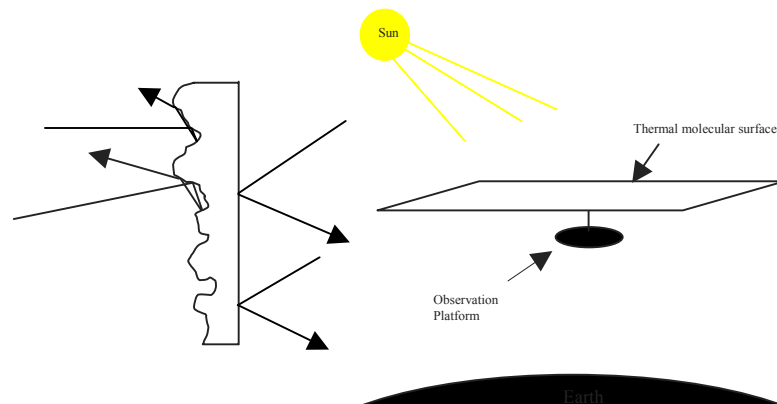
- Self deployable ultralight carbon-carbon microtruss sails have been demonstrated (ESL)
- Using advanced field programmable gate array technology an embedded electronic matrix can be configured into a wide variety of sensors and transmitters.
- The deployable microtruss structure provides a matrix for interferometers, antennas and transmitters that can be configured from a single array.
- Microthrusters can be embedded into the matrix for precise control
- Solar or energy beam propulsion can move the array inexpensively to remote locations.

### Expected Results

- Shows that an inexpensive, self-deploying, reconfigurable sensor is feasible and could serve a wide array of functions in space exploration.
- **How this could benefit the SSP program.**
- Human space exploration will need to adapt quickly to changing environments. A standard inexpensive, reconfigurable, lightweight sensor that has the ability for attitude control and propulsion could be an invaluable scientific tool.



## Thermal Molecular Propulsion for Earth Mesospheric/Mars



The diagram shows how the propulsion method works. Multiple photon collisions on rough side v.s. single collisions on smooth side give differential force. On the right an observation platform is suspended at mesospheric altitudes powered by the Sun.

### Introduction/Background

- Levitation of sail using 100 watt light has been demonstrated under SSP funding .
- Propulsive force is based on differential forces arising in new low mass carbon-carbon sails with different textures on each side.

### SSP Materials Application Provides New Capability

- Earth mesospheric stationary platform and Mars stationary platform for resource/science and human exploration .
- Earth mesospheric/Mars stationary platform
- Research prototype can be deployed by small rocket at high altitude.

### Expected Results

- Technology for revolutionary solar-powered stationary platform will be evaluated for multiple Earth/Mars applications.
- Small prototype platform can form the basis for evaluation of large resource and data gathering applications on Earth and at Mars.

### The Benefit of SSP Technology

- The ability to suspend relatively low-cost platforms indefinitely (at high latitudes) on Mars may be an indispensable aid to Mars exploration and exploitation.



# Results of SSP Laser and Microwave Sail Experiments



## •Task Description

- Performed laser sail tests using coated carbon-carbon sails to gather initial experimental data for proposed flight demonstrations. (See example experimental data)
- Performed microwave sail stability tests and modeled and tested sail spin dynamics.

## •Approach

- Vacuum chamber experiments and analysis performed at microwave and laser frequencies by JPL, ESLI, MSI, UCI and University of New Mexico.

## •Accomplishments/status

- All major objectives accomplished

## •Problems

- Spinning sail proved extremely difficult to model in case of multiple reflections.

## •Future Plans

- Perform additional experiments with the objective of creating enough experimental data for mission design.

